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REC'D 23 DEC 2005



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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference rte.3158.pct.ac.i	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/GB2004/003595	International filing date (day/month/year) 20.08.2004	Priority date (day/month/year) 20.08.2003
International Patent Classification (IPC) or national classification and IPC F16F9/53		
Applicant REACTEC LTD. et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 6 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand 18.03.2005	Date of completion of this report 27.12.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Beaumont, A Telephone No. +31 70 340-3603 	

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/GB2004/003595

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-37 as originally filed

Claims, Numbers

1-25 received on 20.05.2005 with letter of 13.05.2005

Drawings, Sheets

1/7-7/7 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/003595

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-25
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-25
Industrial applicability (IA)	Yes: Claims	1-25
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. Reference is made to the following documents:
D1: PATENT ABSTRACTS OF JAPAN vol. 0090, no. 42 (M-359), 22 February 1985 (1985-02-22) & JP 59 183138 A (NIHON HATSUJIYOU KK), 18 October 1984 (1984-10-18)
D2: US-B1-6 427 813 (CARLSON J DAVID) 6 August 2002 (2002-08-06)
D3: US-A1-6 158 470 (IVERS ET AL.) 12 December 2000 (2000-12-12)
2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 does not involve an inventive step in the sense of Article 33(3) PCT.

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and discloses (the references in parentheses applying to this document):

A variable damper comprising;
an outer member (1) including a magnetically conductive sleeve;
an inner member (2) comprising a shaft;
an electromagnet (4) supported between the members;
wherein a chamber (5,6,7) between the outer and inner members is at least partially filled with magnetorheological fluid, such that when a magnetic field is applied to the chamber, the effective viscosity of the fluid increases such that relative motion of the inner and outer members is opposed;
the electromagnet is supported in the chamber such that it provides a fluid flow path (7) between the inner member and the electromagnet,
the region between the electromagnet and the sleeve defining a control region in which the magnetic field is concentrated.

The subject-matter of claim 1 therefore differs from this known variable damper in that a second fluid flow path is provided between the inner member and the

electromagnet.

The problem to be solved by the present invention may therefore be regarded as improving the performance of the variable damper, especially for low amplitude vibrations.

The solution proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

Document D3 proposes an additional passage in the piston of a magnetorheological damper in order to reduce harshness of the damper (see column 7, lines 1 to 6); this harshness is due to the fact that only a certain frequency range is properly controlled in the case of only one passage.

The skilled person would then combine documents D1 and D3, and thereby arriving at a variable damper according to claim 1.

3. The same reasoning applies, *mutatis mutandis*, to the subject-matter of the corresponding independent claim 12, which therefore is also considered not inventive.
4. Dependent claims do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, see documents D1 to D3 and the corresponding passages of the Written Opinion of the International Search Authority from 15 April 2005.

CLAIMS

1. A variable damper comprising:

- an outer member including a magnetically conductive sleeve;
 - an inner member comprising a shaft;
 - an electromagnet supported between the members;
 - a chamber between the outer and inner members at least partially filled with magnetorheological fluid (MRF), such that when a magnetic field is applied to the chamber, the effective viscosity of the fluid increases such that relative motion of the inner and outer members is opposed; and
- characterized in that
- the electromagnet is supported in the chamber such that it provides a first fluid flow path between the outer member and the electromagnet, and a second fluid flow path between the inner member and the electromagnet; the region between the electromagnet and the sleeve defining a control region in the first fluid flow path in which the magnetic field is concentrated.

2. A variable damper as claimed in Claim 1, wherein the outer member is located within a first housing.

3. A variable damper as claimed in Claim 1, wherein the outer member comprises a first housing.

4. A variable damper as claimed in any one of Claims 1 to 3, wherein the electromagnet is supported on the outer member, such that the first fluid flow path is

1 maintained between the outer member and the
2 electromagnet.

3

4 5. A variable damper as claimed in any preceeding Claim,
5 wherein the electromagnet is supported by a plurality
6 of struts arranged perpendicular to the shaft.

7

8 6. A variable damper as claimed in any one of Claims 1
9 to 3, wherein the electromagnet is supported on the
10 inner member.

11

12 7. A variable damper as claimed in Claim 6, wherein the
13 inner member comprises interconnected first and
14 second shaft portions between which is arranged a
15 second housing comprising the electromagnet.

16

17 8. A variable damper as claimed in any preceding Claim,
18 wherein a diaphragm seal portion is provided at each
19 end of the shaft to bound the chamber.

20

21 9. A variable damper as claimed in Claim 8, wherein the
22 seal portion has an elasticity to allow the inner
23 member to rotate in planes perpendicular to the seal
24 portion.

25

26 10. A variable damper as claimed in Claim 8, wherein the
27 seal portion has an elasticity to reduce at least one
28 degree of freedom of the relative motion of the inner
29 and outer members.

30

31 11. A variable damper as claimed in any preceding Claim,
32 wherein the outer member includes a third housing at
33 least at one body end surface, the/each third housing

1 comprising a hollow cylindrical body including an
2 aperture through which the shaft extends.
3

4 12. A method of variably damping relative motion between
5 an outer member including a magnetically conductive
6 sleeve and an inner member, comprising the steps:
7

8 (a) supporting an electromagnet between the members,
9 such that a first flow path exists between the
10 electromagnet and the sleeve, and a second flow
11 path exists between the electromagnet and the
12 inner member;

13 (b) placing a magnetorheological fluid between the
14 members;

15 (c) applying a minimal magnetic field to the
16 electromagnet;

17 (d) increasing the field in the first flow path; and

18 (e) increasing viscosity of the fluid to thereby
19 oppose relative motion of the members and create
20 damping with minimal off-state.
21

22 13. A vibration control system for reducing vibrations
23 between a first and a second element, comprising a
24 magnetorheological fluid variable damper as claimed
25 in any one of Claims 1 to 11 located between the
26 elements and operated to cause active damping between
27 the elements such that the system has a relative
28 figure of merit of less than 0.83.
29

30 14. A vibration control system as claimed in Claim 13
31 wherein the relative figure of merit is less than or
32 equal to 0.5.
33

1 15. A vibration control system as claimed in any one of
2 Claims 13 or 14 wherein the shaft is connected to the
3 first element and the housing is connected to the
4 second element; and the system further comprises a
5 spring located between elements; first and second
6 accelerometers located between the damper and the
7 respective first and second elements; and a control
8 unit for inputting accelerometer values and
9 outputting a small electric current to the
10 electromagnet, to cause active damping between the
11 first and second elements.
12

13 16. A vibration control system as claimed in any one of
14 Claims 13 to 15 wherein the inner and outer members
15 of the damper are configured to be suitable for
16 attachment to components of a device, such that the
17 application of relative forces between the components
18 results in corresponding forces being applied to the
19 inner and outer members of the damper.
20

21 17. A vibration control system as claimed in Claim 16
22 wherein, a parasitic power generator is incorporated
23 within or on the device to provide the electric
24 current that drives the electromagnet.
25

26 18. A vibration control system as claimed in Claim 16 or
27 Claim 17 wherein, the device comprises at least one
28 sensor that detects a variable, the value of which
29 can be used to determine a desired amount of electric
30 current to be applied to the electromagnetic coil.
31

32 19. A vibration control system as claimed in Claim 18
33 wherein an intelligent control unit (ICU) is

provided, which is capable of receiving input signals from the sensors and outputting command signals to the damper, the command signals being derived from an algorithm used to determine a desired relationship between the input signals and the damping required.

20. A vibration control system as claimed in any one of Claims 16 to 19 wherein the device is a snowboard, one of the outer member and inner member of the damper is attached to the surface board, and the other of the inner member an outer member is attached to a raised portion formed on the board.

21. A vibration control system as claimed in Claim 20 wherein a plurality of dampers are attached to the board.

22. A vibration control system as claimed in Claim 20 or Claim 21 wherein, torsion forks are provided on the board and connected to the inner member of the device to enable control of torsional stiffness of the board.

23. A vibration control system as claimed in any one of Claims 16 to 19 wherein the device of a golf club, one of the outer member and inner member of the damper is attached to the shaft of the club, and the other of the inner member and outer member is attached to or forms the grip of the club.

24. A vibration control system as claimed in any one of Claims 16 to 19 wherein the device is a handle which is a component of a machine, wherein the machine is

1 selected from a group comprising: a tennis racket,
2 polo mallet, sports implement, a household tool, a
3 power drill, a bicycle, a motorcycle, or the like.

4

5 25. A vibration control system as claimed in any one of
6 Claims 16 to 19 wherein, the device is an engine
7 mount, pump mount, or the like.

8

9